

## **AMENDMENTS TO THE CLAIMS**

The following listing of claims will replace all prior versions and listings of claims in the application.

### **LISTING OF CLAIMS**

1. (currently amended) A droplet ejection apparatus having a driving circuit and a plurality of droplet ejection heads, each of the droplet ejection heads including a cavity filled with a liquid, a nozzle communicated with the cavity, an actuator driven by the driving circuit, and a diaphragm displaced by the actuator, the droplet ejection head ejecting the liquid within the cavity through the nozzle in the form of droplets by driving the actuator with the driving circuit, the droplet ejection apparatus comprising:

a main power supply for supplying a power to the apparatus;

power cutoff detecting means for detecting cutoff of the main power supply;

a standby power supply which supplies a power to the apparatus when the power cutoff detecting means detects the cutoff of the main power supply;

residual vibration detecting means for detecting a residual vibration of the diaphragm displaced by the driving of the actuator; and

storage means for storing a vibration pattern of the residual vibration of the diaphragm detected by the residual vibration detecting means and/or information obtained from the vibration pattern; and

ejection failure detecting means for detecting an ejection failure of the droplet ejection heads and a cause thereof;

wherein the droplet ejection apparatus is constructed so that, when the cutoff of the main power supply is detected by the power cutoff detecting means, the actuator is driven by the driving circuit, the residual vibration detecting means detects the residual vibration of the diaphragm displaced by the driving of the actuator, and the storage means stores the vibration pattern of the residual vibration of the diaphragm detected by the residual vibration detecting means and/or the information obtained from the vibration pattern, and wherein the ejection failure detecting means include an oscillation circuit that oscillates in response to an electric capacitance component that varies with the residual vibration of the diaphragm.

2. (Original) The droplet ejection apparatus as claimed in claim 1, wherein the residual vibration of the diaphragm detected by the residual vibration detecting means is a residual vibration of the diaphragm when the actuator is driven by the driving circuit to such an extent that a droplet is not ejected.

3 – 18 (cancelled)

19. (currently amended) The droplet ejection apparatus as claimed in claim 1, ~~further comprising ejection failure detecting means for detecting an ejection failure of the droplet ejection heads and a cause thereof;~~ wherein, when the cutoff of the main power supply is detected by the power cutoff detecting means, the ejection failure detecting means detects an ejection failure of the droplet ejection heads and the cause thereof on the basis of the vibration pattern of the residual vibration of the diaphragm,

and the storage means stores the detection result as the information obtained from the vibration pattern.

20. (Original) The droplet ejection apparatus as claimed in claim 19, wherein the vibration pattern of the residual vibration of the diaphragm includes a cycle of the residual vibration.

21. (Original) The droplet ejection apparatus as claimed in claim 20, wherein the ejection failure detecting means judges that: an air bubble has intruded into the cavity in the case where the cycle of the residual vibration of the diaphragm is shorter than a predetermined range of cycle; the liquid in the vicinity of the nozzle has thickened due to drying in the case where the cycle of the residual vibration of the diaphragm is longer than a predetermined threshold; and paper dust is adhering in the vicinity of the outlet of the nozzle in the case where the cycle of the residual vibration of the diaphragm is longer than the predetermined range of cycle and shorter than the predetermined threshold.

22. (Original) The droplet ejection apparatus as claimed in claim 19, further comprising recovery means for carrying out recovery processing for the droplet ejection heads in accordance with the cause of the ejection failure to eliminate the cause of the ejection failure; wherein, when the main power supply is switched on after the cutoff of the main power supply is detected by the power cutoff detecting means, the recovery means carries out the recovery processing for the droplet ejection heads in accordance

with the cause of the ejection failure to eliminate the cause of the ejection failure by using the detection result stored in the storage means.

23 - 34 (cancelled).

35. (currently amended) The droplet ejection apparatus as claimed in claim 22 49, wherein the recovery means includes: wiping means for carrying out a wiping process in which a nozzle surface of the droplet ejection heads where the nozzles are arranged is wiped with a wiper; flushing means for carrying out a flushing process by which the droplets are preliminarily ejected through the nozzles of the droplet ejection heads by driving the actuator; and pumping means for carrying out a pump-suction process with the use of a pump connected to a cap that covers the nozzle surface of the droplet ejection heads.

36. (currently amended) The droplet ejection apparatus as claimed in claim 22 35, wherein the recovery means carries out the pump-suction process in the case where the cause of the ejection failure of the droplet ejection heads is intrusion of an air bubble into the cavity.

37. (currently amended) The droplet ejection apparatus as claimed in claim 22 35, wherein the recovery means carries out at least the wiping process in the case where the cause of the ejection failure of the droplet ejection heads is adhesion of paper dust in the vicinity of an outlet of the nozzle.

38. (currently amended) The droplet ejection apparatus as claimed in claim 22 35, wherein the recovery means carries out the flushing process or the pump-suction process in the case where that the cause of the ejection failure of the droplet ejection heads is thickening of the liquid in the vicinity of the nozzle due to drying.

39. (cancelled)

40. (currently amended) The droplet ejection apparatus as claimed in claim 1, wherein ~~the ejection failure detecting means includes an oscillation circuit and the oscillation circuit oscillates in response to an~~ the actuator includes the electric capacitance component ~~of the actuator~~ that varies with the residual vibration of the diaphragm.

41. (Original) The droplet ejection apparatus as claimed in claim 40, wherein the ejection failure detecting means includes a resistor element connected to the actuator, and the oscillation circuit forms a CR oscillation circuit based on the electric capacitance component of the actuator and a resistance component of the resistor element.

42. (Original) The droplet ejection apparatus as claimed in claim 40, wherein the ejection failure detecting means includes an F/V converting circuit that generates a voltage waveform in response to the residual vibration of the diaphragm from a

predetermined group of signals generated based on changes in an oscillation frequency of an output signal from the oscillation circuit.

43. (currently amended) A droplet ejection apparatus having a driving circuit and a plurality of droplet ejection heads, each of the droplet ejection heads including a cavity filled with a liquid, a nozzle communicated with the cavity, an actuator driven by the driving circuit, and a diaphragm displaced by the actuator, the droplet ejection head ejecting the liquid within the cavity through the nozzle in the form of droplets by driving the actuator with the driving circuit, the droplet ejection apparatus comprising:

a main power supply for supplying a power to the apparatus;

power cutoff detecting means for detecting cutoff of the main power supply;

a standby power supply which supplies a power to the apparatus when the power cutoff detecting means detects the cutoff of the main power supply;

residual vibration detecting means for detecting a residual vibration of the diaphragm displaced by the driving of the actuator;

storage means for storing a vibration pattern of the residual vibration of the diaphragm detected by the residual vibration detecting means and/or information obtained from the vibration pattern; and

ejection failure detecting means for detecting an ejection failure of the droplet ejection heads and a cause thereof;

wherein the droplet ejection apparatus is constructed so that, when the cutoff of the main power supply is detected by the power cutoff detecting means, the actuator is driven by the driving circuit, the residual vibration detecting means detects the residual

vibration of the diaphragm displaced by the driving of the actuator, and the storage means stores the vibration pattern of the residual vibration of the diaphragm detected by the residual vibration detecting means and/or the information obtained from the vibration pattern, and

wherein the ejection failure detecting means includes an oscillation circuit that oscillates in response to an electric capacitance component of the actuator that varies with the residual vibration of the diaphragm, an F/V converting circuit that generates a voltage waveform in response to the residual vibration of the diaphragm from a predetermined group of signals generated based on changes in an oscillation frequency of an output signal from the oscillation circuit, and ~~The droplet ejection apparatus as claimed in claim 42, wherein the ejection failure detecting means includes a waveform shaping circuit that shapes the voltage waveform in response to the residual vibration of the diaphragm generated by the F/V converting circuit into a predetermined waveform.~~

44. (Original) The droplet ejection apparatus as claimed in claim 43, wherein the waveform shaping circuit includes: DC component eliminating means for eliminating a direct current component from the voltage waveform of the residual vibration of the diaphragm generated by the F/V converting circuit; and a comparator that compares the voltage waveform from which the direct current component thereof has been eliminated by the DC component eliminating means with a predetermined voltage value; and wherein the comparator generates and outputs a rectangular wave based on this voltage comparison.

45. (Original) The droplet ejection apparatus as claimed in claim 44, wherein the ejection failure detecting means includes measuring means for measuring the cycle of the residual vibration of the diaphragm based on the rectangular wave generated by the waveform shaping circuit.

46. (Original) The droplet ejection apparatus as claimed in claim 45, wherein the measuring means has a counter, and measures either a time between rising edges of the rectangular wave or a time between a rising edge and falling edge of the rectangular wave by counting pulses of a reference signal with the counter.

47. (currently amended)The droplet ejection apparatus as claimed in claim 21, wherein the actuator includes an electrostatic actuator.

48. (currently amended) The droplet ejection apparatus as claimed in claim 21, wherein the actuator includes a piezoelectric actuator having a piezoelectric element and using a piezoelectric effect of the piezoelectric element.

49. (currently amended) The droplet ejection apparatus as claimed in claim 21, wherein the actuator includes a film boiling actuator provided with a heating element that generates heat by conducting an electric current thereto.

50. (currently amended)The droplet ejection apparatus as claimed in claim 21 49,



wherein the diaphragm deforms elastically so as to follow a change in the internal pressure of the cavity.

51. (currently amended)The droplet ejection apparatus as claimed in claim 21, wherein the droplet ejection apparatus includes an ink jet printer.

52. (new) A droplet ejection apparatus having a driving circuit and a plurality of droplet ejection heads, each of the droplet ejection heads including a cavity filled with a liquid, a nozzle communicated with the cavity, an actuator driven by the driving circuit, and a diaphragm displaced by the actuator, the droplet ejection head ejecting the liquid within the cavity through the nozzle in the form of droplets by driving the actuator with the driving circuit, the droplet ejection apparatus comprising:

- a main power supply for supplying a power to the apparatus;

- power cutoff detecting means for detecting cutoff of the main power supply;

- a standby power supply which supplies a power to the apparatus when the power cutoff detecting means detects the cutoff of the main power supply;

- residual vibration detecting means for detecting a residual vibration of the diaphragm displaced by the driving of the actuator;

- storage means for storing a vibration pattern of the residual vibration of the diaphragm detected by the residual vibration detecting means and/or information obtained from the vibration pattern;

- ejection failure detecting means for detecting an ejection failure of the droplet ejection heads and a cause thereof; and

recovery means for carrying out recovery processing for the droplet ejection heads in accordance with the cause of the ejection failure detected by the ejection failure detecting means to eliminate the cause of the ejection failure;

wherein the droplet ejection apparatus is constructed so that, when the cutoff of the main power supply is detected by the power cutoff detecting means, the actuator is driven by the driving circuit, the residual vibration detecting means detects the residual vibration of the diaphragm displaced by the driving of the actuator, the storage means stores the vibration pattern of the residual vibration of the diaphragm detected by the residual vibration detecting means and/or the information obtained from the vibration pattern, the ejection failure detecting means detects an ejection failure of the droplet ejection heads and the cause thereof on the basis of the vibration pattern of the residual vibration of the diaphragm, and the storage means stores the detection result as the information obtained from the vibration pattern, wherein the driving of the actuator, the detection of the residual vibration, the storage of the vibration pattern of the residual vibration, and the detection of the ejection failure and the cause thereof are carried out based on the power supplied from the standby power supply, and

wherein the vibration pattern of the residual vibration of the diaphragm includes a cycle of the residual vibration, and the ejection failure detecting means judges that an air bubble has intruded into the cavity in the case where the cycle of the residual vibration of the diaphragm is shorter than a predetermined range of cycle; the liquid in the vicinity of the nozzle has thickened due to drying in the case where the cycle of the residual vibration of the diaphragm is longer than a predetermined threshold; and paper dust is adhering in the vicinity of the outlet of the nozzle in the case where the cycle of

the residual vibration of the diaphragm is longer than the predetermined range of cycle and shorter than the predetermined threshold.

53. (new) The droplet ejection apparatus as claimed in claim 52, wherein, when the main power supply is switched on after the cutoff of the main power supply is detected by the power cutoff detecting means, the recovery means carries out the recovery processing for the droplet ejection heads in accordance with the cause of the ejection failure to eliminate the cause of the ejection failure by using the detection result stored in the storage means.

54. (new) The droplet ejection apparatus as claimed in claim 53, wherein the recovery means includes: wiping means for carrying out a wiping process in which a nozzle surface of the droplet ejection heads where the nozzles are arranged is wiped with a wiper; flushing means for carrying out a flushing process by which the droplets are preliminarily ejected through the nozzles of the droplet ejection heads by driving the actuator; and pumping means for carrying out a pump suction process with the use of a pump connected to a cap that covers the nozzle surface of the droplet ejection heads.

55. (new) The droplet ejection apparatus as claimed in claim 54, wherein the recovery means carries out the pump suction process in the case where the cause of the ejection failure of the droplet ejection heads is intrusion of an air bubble into the cavity.

56. (new) The droplet ejection apparatus as claimed in claim 54, wherein the recovery means carries out at least the wiping process in the case where the cause of the ejection failure of the droplet ejection heads is adhesion of paper dust in the vicinity of an outlet of the nozzle.

57. (new) The droplet ejection apparatus as claimed in claim 54, wherein the recovery means carries out the flushing process or the pump suction process in the case where that the cause of the ejection failure of the droplet ejection heads is thickening of the liquid in the vicinity of the nozzle due to drying.

58. (new) The droplet ejection apparatus as claimed in claim 43, wherein the residual vibration of the diaphragm detected by the residual vibration detecting means is a residual vibration of the diaphragm when the actuator is driven by the driving circuit to such an extent that a droplet is not ejected.

59. (new) The droplet ejection apparatus as claimed in claim 52, wherein the residual vibration of the diaphragm detected by the residual vibration detecting means is a residual vibration of the diaphragm when the actuator is driven by the driving circuit to such an extent that a droplet is not ejected.